USER MANUAL

RTcom–Universal, Global, Europa and Outback Radio Modems

Distributor:
Wessex Power Technology Ltd
189 Ashley Road, Parkstone
Poole, Dorset, BH14 9DL
Tel: +44 (0)1202 723000
Fax: +44 (0)1202 723400
Email: wpt@wessexpower.co.uk
www.wessexpower.co.uk

CONTENTS

INTRODUCTION

The RTcom range of radio modem is intended as a direct replacement for cables over short, medium and long distance serial data links. They are suitable for point-to-point, master to slave or scanning telemetry links, where the modem is either used on its own or in conjunction with existing cables. The modems also operate transparent to many industry standard network protocols, such as MODBUS and EIBA Bus and can be used with many manufacturers PLC communication protocols.

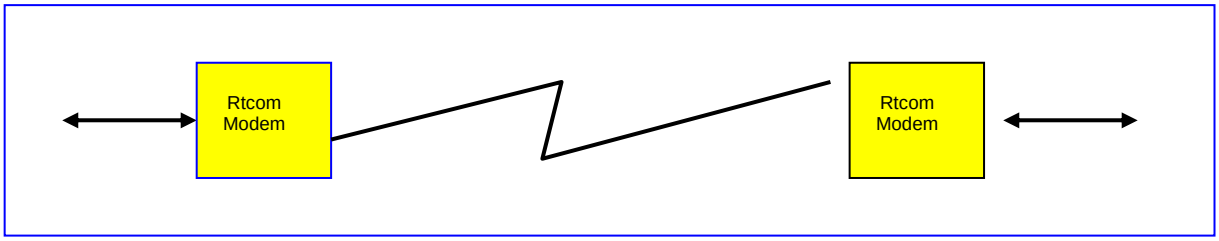


Fig. 1 : Simple point to point link

The advantages of wire free communication offered by Radio Modems such as Radio-Tech's Universal, Global, Europa and Outback are numerous. These include reduced installation cost, the ability to cross awkward terrain, cross third parties lands, cross rivers and operate moving objects. There are even frequency agile systems available for critical applications.

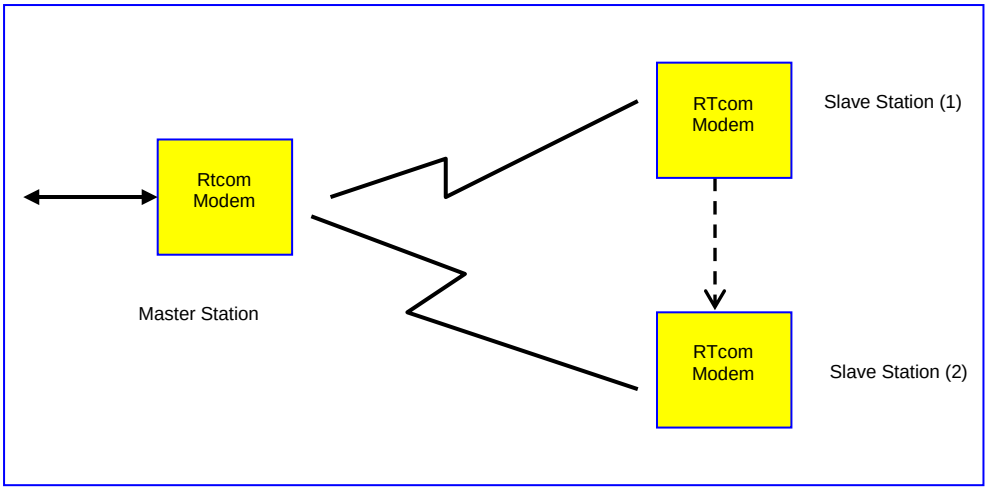


Fig. 2 : Polled Master to multiple slave system

Thousands of RTcom radio modems are now in service throughout the world, many operating 24hrs a day, all year round. However, for any radio communications system to be reliable, care should be taken in the design of the whole system. Many countries impose restrictions on the frequency, power, channel power and occupied bandwidth of transmissions. Others in addition impose strict test and certification procedures on equipment while others permit a free for all!

Frequency of operation :

Often, there is not a choice over operating frequency. In most countries, frequency allocations are very Limited. By way of example, in Europe there is only 433-435MHz UHF or 868-870MHz SHF, while the UK and many others offer extra VHF, UHF and SHF allocations. However, other frequencies may be used subject to local government licence.

In order to generalise the choice of frequency, the decision should be based upon the distance of intended operation, power supply constraints, data rate, duty cycle, attenuation, portability (antenna size) and the presence of other users. The following table is produced to assist your choice.

	VHF (10mW)	UHF (10mW)	UHF (500mW)	SHF(5mW)	SHF (500mW)*
Free Space Transmission range	5-10km	3-5km	10-30km	100-200m	5-10km
Industrial installation In large buildings	50-700m	50-500m	50m-1km	10-30m	30-100m
Penetration through concrete walls	**********	****	******	*	**
Ability to bend / defract around Obstructions	**********	******	******	**	**
Antenna size (dipole)	43cm	17cm	17cm	8cm	8cm
Potential users in adjacent Channels	Message pagers Radio Microphones	Radio Amateur on 433MHz	Radio Amateurs on 433MHz Message Pages on 458MHz and TETRA on 410-430MHz	CT2 Mobile telephones	CT2 Mobile telephones
Transmission efficiency For battery operation	**********	****	****	***	***
Relative cost	***	*****	*****	*******	******

Fig. 3 : Frequency band table

RF Path Surveys :

The only certain way of determining the suitability of a communication channel is to conduct a radio path survey and spectrum scan.

The spectrum scan is something normally conducted prior to ordering a system. Normally, this requires the use of a good quality scanning receiver such as an ICOM 8500 and a broadband antenna. Failure to use a quality scanner may result in signals being missed if channel resolution is too low and false signals being detected if co-channel and image rejection is poor.

When scanning, both the desired and adjacent channels should be checked for signals. As transmissions may be intermittent it is important to take time with the scan, stopping for as long as possible on each channel and looking for at least 15 minutes on the final chosen band.

If there is any doubt over the signal reaching the receiver, a path survey should be conducted. Most modems include a test mode that places the transmitter into constant transmit mode. This permits the measurements of signal strength at the receiver. Normally, our modems will work with a signal level below 1uV (-107dBm). However this may not leave adequate fade margin for the link. Normally a signal better than -104 dBm should be used to provide reasonable margin.

Un-Licenced Operation :

In many countries, it is quite legal to operate systems without the need for operating licences. These countries include the United Kingdom, Australia, New Zealand, Korea, South Africa, Scandinavia, and the majority of Europe. However, operation in these countries is normally subject to the equipment first being approved to a defined standard, such as the UK MPT1329 or the European ETS 300 -220-1, both of which are now encompassed under the R&TTE Directive that came into force on the 8th of April 2000.

Other countries also permit un-licenced operation but with restrictions on power and duty cycle that make it almost impossible for satisfactory modem operation. One example is the United States, where unlicensed transmissions is permitted under FCC-part 15, but only over very short distances or in short sporadic bursts.

Licensed Operation :

In many countries or where security of service dictates, licenced spectrum may have to purchased for your Modem operation.

In the United Kingdom and Europe.

In each case, it must be stressed that the issuing of a licence is at the sole discretion of the licencing authority and Radio-Tech has no automatic right of appeal against a decision made. Normally, preference is given to public utilities and business user licence applications. Rarely are private applications entertained.

IMPORTANT:

Before using your RTcom™ Radio Modem, please ensure that you have purchased the correct version and selected the correct frequency of operation. We have versions with many international approvals ranging from the FCC-Part 90 through to Australia Standards and our European versions carry the CE mark and comply with the "essential requirements" of the R&TTE Directive. If in doubt, please ask your local Radio-Tech Limited agent.

INSTALLATION

Power Supplies :

As with any radio communications system, the RTcom modem should be connected to a clean and stable supply. Switch mode power supplies are rich in RF harmonics and should not be used. Please note that in many cases, a CE sticker on a power supply is insufficient protection against potentially damaging harmonics. The reality is that the EMC pass limits are set at only -57dBm (31uV), whereas a radio is quite capable of operation down to and beyond -115dBm (0.5uV). Hence, a power supply is capable of legally generating harmonics quite capable of blocking a radio modems operating channel.

As a word of warning the frequency of the offending harmonics can shift with both ambient temperature, time and power supply load. Please do not be fooled into thinking that a system is operating correctly. There has been a number of reported cases of radio blocking due to power supply switching frequency variations. Hence, as a rule of thumb, we only recommend the use of linear power supplies. Similarly where supply interruption is to be protected against, we recommend the use of float charged batteries (12V or 24V dc) and not switching UPS's.

Location :

For indoor installations, we recommend that the modem is located away from sources of heat and electrical apparatus such as Inverters. Care has to be taken to minimise cable lengths both with respect to the antenna location and the attached terminal equipment. Generally, RS232 should be used for short distance links < 30ft (10m) and RS422 / RS485 for long links of up to 1000ft (300m). In practise, the maximum distance achievable will depend upon the combination of the drive capability of both modem and data terminal.

The IP-65 rating of the modem enclosure would to many imply that it could be operated outdoors in all weather conditions. Experience has shown this to be true, but operation can be jeopardised through long term exposure to rain, frost, direct sunlight, and blown sand. For these reasons, we also recommend, where possible, the modem should be mounted within a second enclosure of a similar IP rating and where the climate is variable, a thermostatically controlled anti-condensation heater be used. This practise has been used by our own field service engineers for many years and has proven very successful.

For battery powered operation in cold damp climates, the only reliable way to achieve long term operation is to use double IP-65/7 enclosures, with both the outer and inner enclosure fitted with silica gel desiccant sachets.

Please be aware that solar heating and wind chill can take the modem beyond its designed operating temperature range. Further, thermal cycling can encourage moisture ingress due to pressure changes. Whenever necessary, please fit your enclosure with wind deflectors and/or sunshades.

Antenna Feeders :

The basic rule of thumb is the greater the length of cable, the greater the loss. Always attempt to keep cable runs to a minimum and whenever possible, use the lowest loss cable available. Both cables and terminations should always be of 50 Ohm impedance. Cable bends should not be too tight i.e. the radius of the bend should be greater than 10 x the diameter of the cable.

It is important to remember that coaxial cables have losses proportional to their length and quality. The following table gives loss figures from typical popular 50 Ohm coaxial cables :-

		DB Loss per 10m length	
Cable Type	**Dia**	**100MHz**	**1000MHZ**
RG58	5.0	2.0	7.6
URM67	10.3	0.68	2.52
URM76	5.0	1.6	5.3

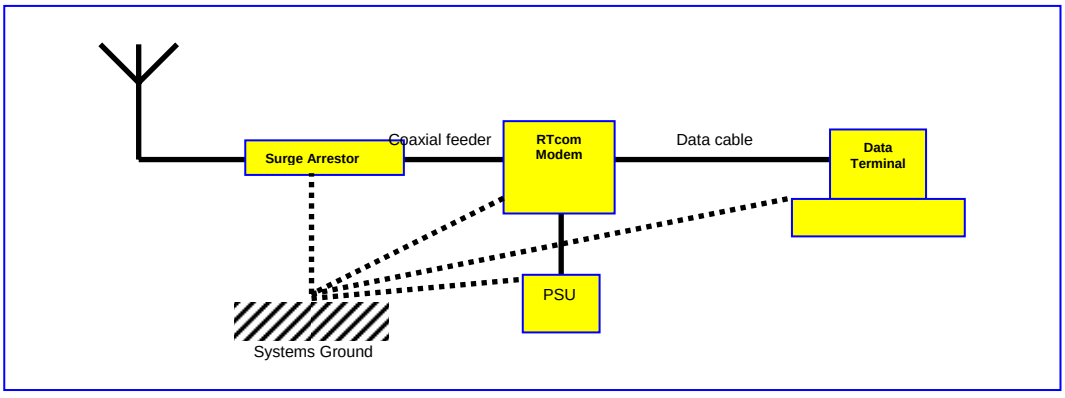
Fig. 4 : Cable types

Our modems are normally supplied with N-type terminators (sockets). Other terminations (BNC or TNC) can be supplied to customer specific orders. Generally, we find the N-Type to be the most reliable, robust and readily available that can accommodate essentially all cables including low loss URM67.

Lightning Surge Protection :

A direct lightning strike can never be totally protected against or predicted. Currents exceeding 10,000A can flow vaporising antenna, feeders, towers and other such structures. Lightning conductors will give a degree of protection to the building but not to the electronic apparatus within.

Generally, the probability of a direct strike is very small, but a nearby strike, for example, within a 1km radius can be quite a regular occurrence in many locations. Nearby strikes or “strokes” can lead to the creation of large EM waves that can induce large voltages into antenna, feeders, signal wires and PSUs.



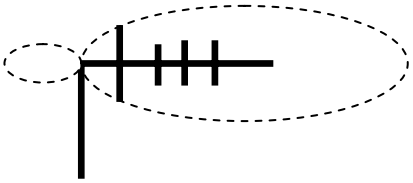
The best form of protection is to use a surge arrestor. The arrestor connected in series between the antenna and the modem is intended to safely limit the induced voltage. However, a surge arrestor can only be effective if the impedance of the cable connecting it to ground is lower or equal to that of the modem and the other connected apparatus. Secondly, they are only effective if all connections are to a common Earth point.

Note: Failure to connect the data terminal to the same Earth point compromises the protection of the apparatus. If, however, is not practical to implement, then a second surge protection devise should be connected in series with the data and/or power connections, again bonded to the common Earth point.

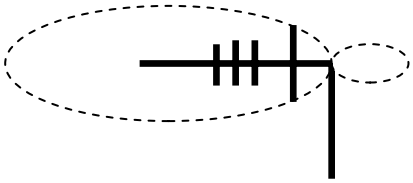
Antenna Installation :

The type and location of the antenna used can have a profound effect on your overall system performance and its legality.

In point to point links, it is good practice to make efficient use of the radio spectrum by selecting an antenna that will project the RF energy into the direction of desired operation and similarly at the receiver to collect transmissions only from the location of the transmitter.

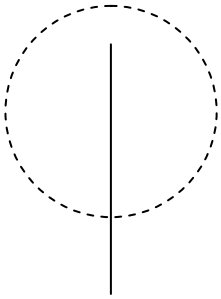


(Directional Yagi antenna (vertically polarised)

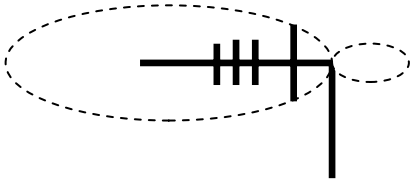


(Directional Yagi antenna (vertically polarised)

In polled systems, where there is a central base station, the base station will need an omni-directional antenna. However, the outstations may still employ a directional antenna pointing back to the base station.



(Omni-direction antenna (vertical polarised))



(Directional Yagi antenna (vertically polarised)

For mobile systems the only practical choice is to use omni-directional antenna at all stations.

It is very important that all antennas in a system share the same polarisation otherwise losses of up to 30dB may be encountered

Note: Polarisation can be put to good use when it is desirable to reject an unwanted transmission on the same or a similar frequency.

Warning: The use of gain antenna in some countries is not permitted. Similarly, where ERP (transmitter power limits) are imposed, the actual transmitted power must not exceed the limit stated. This means that the transmitter output power, less any coaxial feeder losses, plus the antenna gain must not exceed the specified maximum ERP. Before installing your system, please check!

Antenna Options :

Antenna types fall to a number of categories. For the majority of applications, the choice lies between portable, fixed, omni-directional and those with gain and directional properties.

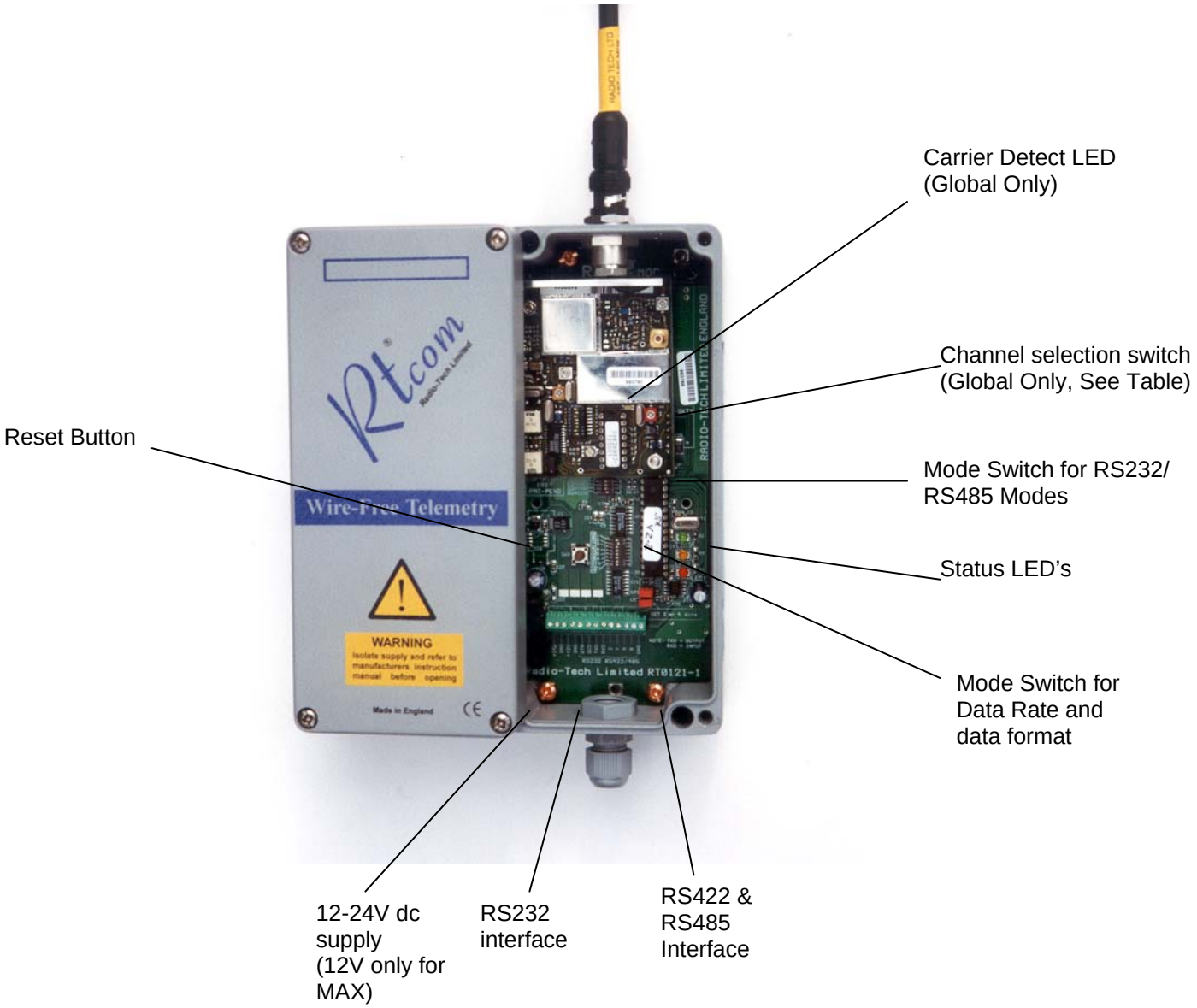
True omni-directional antenna in reality do not exist, i.e. those with equal gain in all directions. However, the nearest practical equivalent is the 1/2 or 1/4 wave dipole. The 1/4 wave dipole is by far the most popular of all antennas and is found in use on most portable apparatus. Where the frequency is too low and the dipole can become cumbersome, a compressed dipole (helical) antenna can be used.

Whatever antenna types you choose, please ensure that its impedance is 50 Ohms.

Name	Gain and Directional Properties	Comments
1/4 wave dipole	< -0.8dB near omni in the vertical plane only.	For portable apparatus operating 400MHz Requires a ground plane for operation.
Helical	< -4dB to -10dB near omni in the vertical plane only	For portable apparatus <-400MHz Requires a ground plane for operation
1 /2 wave dipole	+1.2 to +1.8dB near omni-directional in the vertical plane.	For portable and fixed apparatus looking for a low cost antenna that does not require a ground plane
End fed dipole	0dB, near omni in vertical plane	For fixed apparatus that does not require a Ground plane
Colinear	+3dB to +9dB, near omni-directional in vertical plane	For fixed apparatus that does not require a ground plane
Yagi	+3dB to +28dB. Beam width proportional to gain	For point to point links. Where an unwanted signal needs to be blocked from the opposite direction choose an antenna with a high front to back ratio

GENERAL ARRANGEMENT

Guide to your RTcom™ - Global and Universal (Global Illustrated)



Guide to your RTcom - Outback

Configuration Mode Switch

Links to select 2-4 wire RS485

Solar/ 12-24V dc supply

RS232 interface

RS422 & RS485 Interface

CONNECTIONS

Data and Power :

Data connections should always be made using screened cable. This will ensure maximum rejection of interference from outside interfering sources. Always use a common ground point.

The RTcom Global, Europa and Outback modems support RS232, RS422 and RS485 communications, both 2 and 4 wire. The RS232 port should be used for short cable runs of up to 10m and the RS422 and RS485 can be used for extended distances. The modems support various data rates from 1200 to 9600bps depending upon version. All units support 7- and 8- bit ASCII data with even or odd parity and 1 or 2 stop bits.

Terminal Number	Designation WRT Modem (-Global)	Notes
1	+24V dc supply	Supply
2	GND	Ground
3	+12V dc supply	Supply/Ground
4	GND	Ground
5	DTR	Optional not normally needed
6	DCD	Optional not normally needed
7	TXD (RS232)	Output data from modem
8	RXD (RS232)	Input data to modem
9	Z = TX (-)	RS485 / RS422
10	Y = TX (+)	“
11	A = RX (+)	“
12	B = RX (-)	“
13	GND	Ground

Tab. 1 : Connections for the Global Modems

Terminal Number	Designation WRT Modem	Notes
1	+24V dc supply	
2	GND	Ground
3	+12V dc supply	
4	GND	Ground
5	TXD (RS23)	Output data from modem
6	RXD (RS232)	Input data to modem
7	Y = TX (+)	RS485 / RS422
8	Z = TX (-)	“
9	B = RX (-)	“
10	A = RX (+)	“
11	GND	Ground

Tab. 2 : Connections for the RTcom – Europa Modem

Data and Power cont'd :

Pin number	Designation WRT Modem	Notes
1	DCD	Optional not normally needed
2	RX (data)	RS232 input data to modem
3	TX (data)	RS232 output data from modem
4	RTS	Optional not normally needed
5	GND	Ground
6	B = RX (-)	RS485 / RS422
7	A = RX (+)	"
8	+Vs	Supply 7.5 to 15V dc
9	N/C	No Connection
10	GND	Ground
11	Z = TX (-)	RS485/RS422
12	Y = TX (+)	"
13	+Vs	Optional supply connection
14	GND	Optional
15	+Vs	Optional supply connection

Tab. 3 : Connection for the Universal & Plastic Housed Global Modem

NB. with RS422 & RS485 connections, it is the responsibility of the system builder to ensure that the connections are correctly terminated. Normally, cables with an impedance of greater than 100 Ohms should be used and terminating resistors (120R between A-B and Z-Y) may also be required.

CONFIGURATION

Operating Modes :

Depending upon the model of the modem you will be able to select one of the communication configurations listed below :-

VHF : MPT1328 RTcom-Outback	UHF : MPT1329 RTcom-Outback	UHF: MPT1329 RTcom-Global
1200-2400bps	1200-4800bps	2400-9600bps
7 & 8 bit ASCII	7 & 8 bit ASCII	7 & 8 bit ASCII
Even & odd parity	Even & odd parity	7 & 8 bit ASCII
1 or 2 stop bits	1 or 2 stop bits	1 or 2 stop bits

Tab. 4 : Operating Modes available with the Global, and Outback Modems

On the Global and Max modems, two DIP switches are provided for the selection of the desired operating mode and two plug links are provided for the selection of 2 wire (RS422) or 4 wire (RS485) operation. A further DIP switch is provided for frequency channel selection. (See table at end of manual for specific frequency options).

Data Format :

Switch Number	Function
1	Baud Rate (See Table)
2	Baud Rate (See Table)
3	8 or 9 bit data (OFF = 8-bit ; ON = 9-bit) (excluding 1 start and stop bit)
4	Not used on Global / Universal
5	Not used on Global / Universal
6	Spare
7	Test mode (see below)
8	Test mode (see below)

Tab. 5 : Switch function SW1 (Universal & Global)

Interface :

Switch Number	Function
1	Spare
2	OFF = RS232 ; ON = RS485/RS422
3	ON = RS485 / RS422
4	ON = RS232

Tab. 6 : Mode Switch SW2 (RTcom - Universal & Global)

Data Rate :

Mode SW1,1	Mode SW1,2	Data Rate- Universal 2	Date Rate- Global	Data Rate - Global 1200
OFF	OFF	9600 bps	2400 bps	1200 bps
ON	OFF	19200 bps	4800 bps	2400 bps
OFF	ON	38400 bps	9600 bps	4800 bps
ON	ON	57600 bps	9600 bps	4800 bps

Tab. 7 : Date Rate setting table subject to version constraints listed above.

Switch No	Function	Notes	Rev
1	Selects RS232	Only switch 1 or 2 should be ON	
2	Selects RS485	" "	
3	Not used		
4	Not used		
5 & 6	Data rate	9600 19200 38400 57600 5 OFF ON OFF ON 6 OFF ON ON ON	
7	Data bits + parity	ON = 9 ; OFF = 8	
8	Test mode	ON = Test mode Mode 1: Switch 7 OFF : Test message transmitted every 2 seconds Mode 2 : Switch 7 ON : Constant carrier with modulation.	

Tab. 8 : Switch Function (RTcom - Universal)

Test modes :

Test modes are provided to assist installation. Whenever test mode is selected the modem will produce a test transmission to aid both antenna alignment and propagation tests.

Mode SW1, 7	Mode SW1, 8	RTcom Universal	RTcom Global	RTcom Global 1200 (special)
OFF	OFF	No test mode	No test mode	No test mode
OFF	ON	TESTMODE 1	TESTMODE 1	TESTMODE 1
ON	OFF	TESTMODE 2	TEST MODE 3	TEST MODE 2
ON	ON	TEST MODE 1	TEST MODE 1	TEST MODE 1

Tab. 9 : Test modes (Universal & Global)

TESTMODE 1 : This enables the RF transmitter and transmits a tone at the selected baud rate (mark : space ratio = 1:1)

TESTMODE 2 : This enables the RF transmitter and transmits a tone at the selected baud rate (mark : space ratio = 2:1)

TESTMODE 3 : This transmits a fixed 24 character string every 0.5 seconds.
String : RTcom GLOBAL Tx No * where * increments from 0 to 9 repeatedly. The receiver modem will detect this string and pass it onto its host. However it will also count the number of characters in the packet (24) and light the 'Red' LED to indicate valid packet. This LED will extinguish within 1 second unless another test packet is detected. Therefore, during a site survey, if the 'red' LED stays lit while the transmitter transmits the test packet, the link is reliable. Adding signal attenuators in the coaxial cable will reduce the signal strength and the margin can be measured at the point the LED starts flashing or extinguishes.

OPERATION

The RTcom™ protocol permits 100% transparent operation and direct cable emulation. Simply what goes in comes out! R.F packet framing, code balancing, encryption and preambles etc are taken care of automatically within the modem.

Standard industrial communications protocols such as MODBUS include a secure CRC 16 or 32 error check code on data transfers and will probably already be in use over your link, particularly if you are linking PLC's. Rather than duplicate the CRC and risk increasing the overall bit error rate, the RTcom protocol does not add any further error checking and subsequent time delay to your messages.

Status LED's :

Status LED's are provided to aid use. On the global and Universal, the top green LED indicates power and the CPU status. If all is well, the LED will blink at a regular interval.

The centre amber LED is for received data communications (message received or sent to the data terminal) by cable.

Finally, the bottom red LED indicates the transmission of data.

All LED's Blink!:

If all LED's should blink together, this indicates a data configuration error that is normally triggered by the occurrence of a framing error. This is generally caused by the data rate and/or parity etc being incorrect at the transmitting end. Manual intervention, i.e. changing the dip switches and/or the data terminal will be required. NB. both ends of the link must share the same configuration.

Alternatively, this could also indicate incorrect wiring polarity of RS485 / RS422 connections.

Only after pressing and releasing the reset button will the new configuration become effective.

COMMISSIONING

The data rate, parity and number of data bits are set using the dual in line switch located above. If a scanner is available the chosen channels and the adjacent channels should be scanned for activity.

With frequency agile products such as the -Global, a free channel should be selected as far away as possible form the channel/s in use.

The antenna should be positioned and one modem connected and set to test mode. The scanner should be used to measure the received signal strength. If the strength is >1uV, the link will normally work however, a “fade margin” of > +10dB is preferable.

Finally, once the installation is complete, it should be tested for EMC conformance, Health & Safety and Wiring Regulations etc. Exposed joints should be sealed using self-amalgamating tape and screw threads coated with rust proofing compound.

COMMUNICATION PROTOCOLS

RTcom Protocol :

The RTcom™ Communication protocol does not make any attempt to correct communication errors. From experience, the latency (delay) caused by error correction techniques is prohibitive for the majority of applications. Further the use of a “transmit” buffer imposes a finite file size on the system and hence, introduces the need for flow control lines such as DTR. Further, errors can occur in cabling due to induced switching surges, nullifying any error protection on the radio link.

Proprietary Protocols :

The majority of our customers use a cable protocol that already employs error checking. This normally comes in the form of a check sum appended to the end of the message. Similarly, addressing can be appended to the message giving the destination of the data. Protocols such as MODBUS and EIBA Bus handle these functions automatically.

Windows™ TERMINAL and HYPER TERMINAL :

Windows™ depending upon its version contains terminal (Terminal.EXE or HyperTerminal.EXE) programs that can be used to transfer files between two platforms. From experience we have found that Windows™ 3.11 version Terminal.exe to be far more reliable than the Windows™ 95 or 98 versions. The 98 version has however, been improved but performance will vary from machine to machine. The problem we believe with these programs is the low priority placed on communications by the system. This results in the messages becoming fragmented, thus confusing the modem into thinking the end of file has been detected.

The other common problem, in particular with Windows™ Hyper Terminal, is the way in which it deals with errors. Should an error occur it attempts to re-establish the link from both ends simultaneously, something of course that can not be supported on a half duplex link.

EMC CONFORMITY

Finished products placed on the market within the EU must be EMC Type examined. Where applicable, the RTcom-Modems have been Type examined in their own right or contain a Type Examined radio transceiver module.

Where applicable a Type Examination / EMC Declaration of conformity will be attached to this manual.

Specification – General European 433.xxx MHz (ETS 300 220) Model

(ROM 3802-0083 and ROM 5501_01)

CHANNEL CENTRE FREQUENCY (MHz)	SWITCH SETTINGS						ROM SELECTION NUMBER
	S1/1	S1/2	S1/3	S1/4	S1/5	S1/6	
433.075	ON	ON	ON	ON	ON	ON	0
433.100	ON	ON	ON	ON	ON	OFF	1
433.125	ON	ON	ON	ON	OFF	ON	2
433.150	ON	ON	ON	ON	OFF	OFF	3
433.175	ON	ON	ON	OFF	ON	ON	4
433.200	ON	ON	ON	OFF	ON	OFF	5
433.225	ON	ON	ON	OFF	OFF	ON	6
433.550	ON	ON	ON	OFF	OFF	OFF	7
433.275	ON	ON	OFF	ON	ON	ON	8
433.300	ON	ON	OFF	ON	ON	OFF	9
433.325	ON	ON	OFF	ON	OFF	ON	10
433.350	ON	ON	OFF	ON	OFF	OFF	11
433.375	ON	ON	OFF	OFF	ON	ON	12
433.400	ON	ON	OFF	OFF	ON	OFF	13
433.425	ON	ON	OFF	OFF	OFF	ON	14
433.450	ON	ON	OFF	OFF	OFF	OFF	15
433.475	ON	OFF	ON	ON	ON	ON	16
433.500	ON	OFF	ON	ON	ON	OFF	17
433.525	ON	OFF	ON	ON	OFF	ON	18
433.550	ON	OFF	ON	ON	OFF	OFF	19
433.575	ON	OFF	ON	OFF	ON	ON	20
433.600	ON	OFF	ON	OFF	ON	OFF	21
433.625	ON	OFF	ON	OFF	OFF	ON	22
433.650	ON	OFF	ON	OFF	OFF	OFF	23
433.675	ON	OFF	OFF	ON	ON	ON	24
433.700	ON	OFF	OFF	ON	ON	OFF	25
433.725	ON	OFF	OFF	ON	OFF	ON	26
433.750	ON	OFF	OFF	ON	OFF	OFF	27
433.775	ON	OFF	OFF	OFF	ON	ON	28
433.800	ON	OFF	OFF	OFF	ON	OFF	29
433.825	ON	OFF	OFF	OFF	OFF	ON	30
433.850	ON	OFF	OFF	OFF	OFF	OFF	31
434.000	OFF	ON	ON	ON	ON	ON	32
434.025	OFF	ON	ON	ON	ON	OFF	33
434.050	OFF	ON	ON	ON	OFF	ON	34
434.075	OFF	ON	ON	ON	OFF	OFF	35
434.100	OFF	ON	ON	OFF	ON	ON	36
434.125	OFF	ON	ON	OFF	ON	OFF	37
434.150	OFF	ON	ON	OFF	OFF	ON	38
434.175	OFF	ON	ON	OFF	OFF	OFF	39
434.200	OFF	ON	OFF	ON	ON	ON	40
434.225	OFF	ON	OFF	ON	ON	OFF	41
434.250	OFF	ON	OFF	ON	OFF	ON	42
434.275	OFF	ON	OFF	ON	OFF	OFF	43
434.300	OFF	ON	OFF	OFF	ON	ON	44
434.325	OFF	ON	OFF	OFF	ON	OFF	45
434.350	OFF	ON	OFF	OFF	OFF	ON	46
434.375	OFF	ON	OFF	OFF	OFF	OFF	47
434.400	OFF	OFF	ON	ON	ON	ON	48
434.425	OFF	OFF	ON	ON	ON	OFF	49
434.450	OFF	OFF	ON	ON	OFF	ON	50
434.475	OFF	OFF	ON	ON	OFF	OFF	51
434.500	OFF	OFF	ON	OFF	ON	ON	52
434.525	OFF	OFF	ON	OFF	ON	OFF	53
434.550	OFF	OFF	ON	OFF	OFF	ON	54
434.575	OFF	OFF	ON	OFF	OFF	OFF	55
434.600	OFF	OFF	OFF	ON	ON	ON	56
434.625	OFF	OFF	OFF	ON	ON	OFF	57
434.650	OFF	OFF	OFF	ON	OFF	ON	58
434.675	OFF	OFF	OFF	ON	OFF	OFF	59
434.700	OFF	OFF	OFF	OFF	ON	ON	60
434.725	OFF	OFF	OFF	OFF	ON	OFF	61
434.750	OFF	OFF	OFF	OFF	OFF	ON	62
434.775	OFF	OFF	OFF	OFF	OFF	OFF	63

PROM Specification – UK 458.xxx MHz (MPT1329) Model

(ROM 3802-0084 Issue 1 for DTR 100)

CHANNEL CENTRE FREQUENCY (MHz)	SWITCH SETTINGS						ROM SELECTION NUMBER
	S1/1	S1/2	S1/3	S1/4	S1/5	S1/6	
458.700	ON	ON	ON	ON	ON	ON	0
458.775	ON	ON	ON	ON	ON	OFF	1
458.750	ON	ON	ON	ON	OFF	ON	2
458.775	ON	ON	ON	ON	OFF	OFF	3
458.525	ON	ON	ON	OFF	ON	ON	4
458.550	ON	ON	ON	OFF	ON	OFF	5
458.575	ON	ON	ON	OFF	OFF	ON	6
458.600	ON	ON	ON	OFF	OFF	OFF	7
458.625	ON	ON	OFF	ON	ON	ON	8
458.650	ON	ON	OFF	ON	ON	OFF	9
458.675	ON	ON	OFF	ON	OFF	ON	10
458.700	ON	ON	OFF	ON	OFF	OFF	11
458.725	ON	ON	OFF	OFF	ON	ON	12
458.750	ON	ON	OFF	OFF	ON	OFF	13
458.775	ON	ON	OFF	OFF	OFF	ON	14
458.525	ON	ON	OFF	OFF	OFF	OFF	15
458.550	ON	OFF	ON	ON	ON	ON	16
458.575	ON	OFF	ON	ON	ON	OFF	17
458.600	ON	OFF	ON	ON	OFF	ON	18
458.625	ON	OFF	ON	ON	OFF	OFF	19
458.650	ON	OFF	ON	OFF	ON	ON	20
458.675	ON	OFF	ON	OFF	ON	OFF	21
458.700	ON	OFF	ON	OFF	OFF	ON	22
458.725	ON	OFF	ON	OFF	OFF	OFF	23
458.750	ON	OFF	OFF	ON	ON	ON	24
458.775	ON	OFF	OFF	ON	ON	OFF	25
458.525	ON	OFF	OFF	ON	OFF	ON	26
458.575	ON	OFF	OFF	ON	OFF	OFF	27
458.625	ON	OFF	OFF	OFF	ON	ON	28
458.675	ON	OFF	OFF	OFF	ON	OFF	29
458.725	ON	OFF	OFF	OFF	OFF	ON	30
458.775	ON	OFF	OFF	OFF	OFF	OFF	31
458.750	OFF	ON	ON	ON	ON	ON	32
458.725	OFF	ON	ON	ON	ON	OFF	33
458.700	OFF	ON	ON	ON	OFF	ON	34
458.675	OFF	ON	ON	ON	OFF	OFF	35
458.650	OFF	ON	ON	OFF	ON	ON	36
458.625	OFF	ON	ON	OFF	ON	OFF	37
458.600	OFF	ON	ON	OFF	OFF	ON	38
458.575	OFF	ON	ON	OFF	OFF	OFF	39
458.550	OFF	ON	OFF	ON	ON	ON	40
458.525	OFF	ON	OFF	ON	ON	OFF	41
458.550	OFF	ON	OFF	ON	OFF	ON	42
458.575	OFF	ON	OFF	ON	OFF	OFF	43
458.600	OFF	ON	OFF	OFF	ON	ON	44
458.625	OFF	ON	OFF	OFF	ON	OFF	45
458.650	OFF	ON	OFF	OFF	OFF	ON	46
458.675	OFF	ON	OFF	OFF	OFF	OFF	47
458.700	OFF	OFF	ON	ON	ON	ON	48
458.725	OFF	OFF	ON	ON	ON	OFF	49
458.750	OFF	OFF	ON	ON	OFF	ON	50
458.775	OFF	OFF	ON	ON	OFF	OFF	51
458.750	OFF	OFF	ON	OFF	ON	ON	52
458.725	OFF	OFF	ON	OFF	ON	OFF	53
458.700	OFF	OFF	ON	OFF	OFF	ON	54
458.675	OFF	OFF	ON	OFF	OFF	OFF	55
458.650	OFF	OFF	OFF	ON	ON	ON	56
458.625	OFF	OFF	OFF	ON	ON	OFF	57
458.600	OFF	OFF	OFF	ON	OFF	ON	58
458.575	OFF	OFF	OFF	ON	OFF	OFF	59
458.550	OFF	OFF	OFF	OFF	ON	ON	60
458.525	OFF	OFF	OFF	OFF	ON	OFF	61
458.550	OFF	OFF	OFF	OFF	OFF	ON	62
458.525	OFF	OFF	OFF	OFF	OFF	OFF	63